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KINEMATICS OF A REAR BODY OF A FLAT PLOWING PLOUGH WITH A TURNING SHAFT

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Annotation. In this paper, the kinematics of a tipping deck is investigated. The main types of palax movement are analyzed — turning, sliding and tipping. Using kinematic modeling, methods for determining the parameters of Pallas's velocity and acceleration, and representing the trajectory of motion are considered. The physical properties of palax motion are also analyzed based on the graphical representation of motion, communication conditions, and equations of state. This topic plays an important role in the deep understanding of the motion of complex bodies in mechanics and engineering sciences.

Key words: kinematic research, motion, properties, analysis, palax, cross section, angle.

Introduction. In kinematic studies, we do not take into account the forces that cause the blade to rotate during the overturning process of the blade under the influence of the rear body of the plow and the guide. In this case, we assume that the cross-section of the blade is unchanged.

The process of turning and overturning a plank consists of the following stages: lifting the plank without moving the center of gravity laterally and rotating it until its cross-section assumes a diagonally upright position, turning the plank with the center of gravity laterally and laying it on its side.

Main part. In the first stage, the beam is lifted by the edge D until its cross section is diagonally vertical (overturning from 0 to β1), in which case the beam rotates without the center of gravity moving laterally (Figure 1). At this stage, the beam is rotated by an angle of (π/2-φ)

$$\beta_1 = \frac{\pi}{2} - arctg\,\frac{a}{b}. \qquad (1)$$

In this case, the center of gravity of the pendulum rises

$$\Delta z_1 = \frac{1}{2}(\sqrt{a^2 + b^2} - a). \qquad (2)$$

In the second stage, the pendulum rotates with the center of gravity moving transversely from (π/2-φ) to (π/2+φ) on the edge D. In this case, it assumes a vertical position. In this case, its rotation angle is

$$\beta_2 = \frac{\pi}{2} - arctg\,\frac{a}{b}. \qquad (3)$$

The coordinate of the center of gravity of the pendulum in the second stage

$$\Delta z_2 = \frac{1}{2} b_p. \qquad (4)$$

In the third stage, the pallet rotates with a transverse displacement of the center of gravity from π/2+φ to π until it rests on the groove formed by the double body, resting on the edge S.

The motion of the pallets at each stage is described by equations.

To study the motion of the pallet, we assume the following conditions:

1. When the pallet rotates from 0 to (π/2-φ), the center of gravity of the layer should not move along the X axis;

2. The pallet must rotate without separating from the bottom of the groove;

3. The shape of the cross-sectional surface of the pallet does not change during rotation.

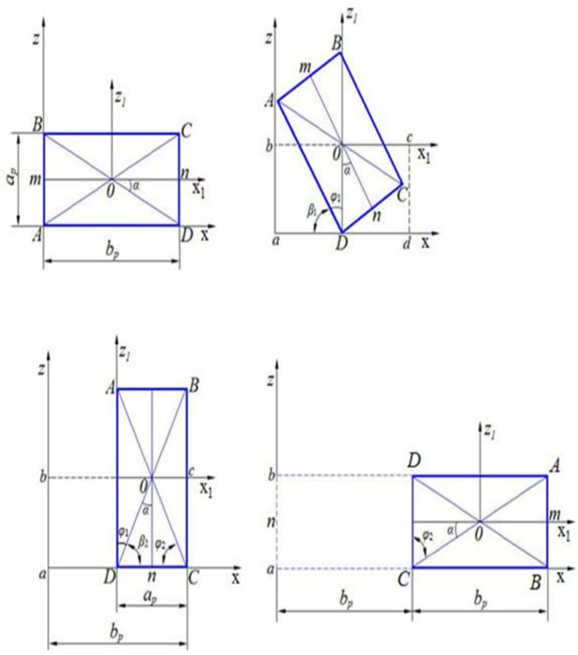

Figure 1. Scheme of the process of rotation and overturning of the pallet

We formulate the equation of motion for the i-th point of the pallet in the form of coordinates. For this, we construct a fixed rectangular coordinate system with point A Axyz (Figure 1). We direct the U axis in the direction of motion and place it along the bottom of the ditch, the X axis is perpendicular to the direction of motion and place it along the bottom of the ditch. The Z axis coincides with the side edge of the pallet AB.

We place the moving coordinate system OX1U1Z1 at the center of gravity O of the cross-section of the layer,

in which it moves with speed relative to the fixed coordinate system AXUZ, while their corresponding axes remain parallel.

In the moving coordinate system OX1U1Z1, the trajectory equations of the i-th point of the layer have the following form

$$\left.\begin{aligned} X_1 &= R_i\cos(\varphi_i+\omega t)\\ y_1 &= 0\\ Z_1 &= R_i\sin(\varphi_i+\omega t)\end{aligned}\right\} \qquad (5)$$

where Ri is the distance from the coordinate origin 0 to the

I - th point of the layer being investigated in the cross section;

φi - is the angle between the axis X1 and the radius Ri in the OX1U1Z1 system;

ω - is the instantaneous value of the angular velocity;

t - is the value of the elapsed time.

Based on Figure 1, we determine the coordinates of the center of gravity of the pendulum along the X and Z axes when it rotates around point D from π/2 to (π/2+φ1) according to the following equation

$$\begin{aligned} X &= \frac{b}{2}+\frac{1}{2}\sqrt{a_2+b_2}\,\sin(\varphi_i+\omega_i t),\\ Z &= \frac{1}{2}\sqrt{a^2+b^2}\,\cos(\varphi_i+\omega_i t),\end{aligned} \qquad (6)$$

where φi - is the angle between the diagonal of the pendulum and its side AD;

ωi - is the angular velocity of the pendulum's rotation around point D.

Based on Figure 1.d, we determine the coordinate of the center of gravity of the pendulum along the X and Z axes from π/2 to (π/2+φ2) when it rotates around point S according to the following equation

$$\begin{aligned} X &= \frac{b}{2}+\frac{1}{2}\sqrt{a_2+b_2}\,\sin(\varphi_c+\omega_i t),\\ Z &= \frac{1}{2}\sqrt{a^2+b^2}\,\cos(\varphi_c+\omega_i t),\end{aligned} \qquad (7)$$

where φc - is the angle between the diagonal of the beam and its side CD;

ωi - is the angular velocity of the beam rotation around point D.

Conclusion. According to equations (5), (6) and (7), it is possible to construct a kinematic diagram of the motion of the characteristic points of the beam during rotation. Analysis of these equations showed that the motion of the points of the beam occurs along a smooth line. The obtained equations can be used in the design of the rear body and guides.

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